class and was built in 1888. An interesting fact with regard to sedimentation in this reservoir is that during the twelve years of its use the bed of accumulated silt in the deepest part (some 90 ft.) was only 3 ft. in thickness. This is in great contrast with the rapid silting of Lake Macdonald, the reservoir created by the Austin dam of Texas, whose design and construction, and also final failure in April, 1900, are described by Mr. Schuyler.

Concrete dams are next taken up, including the structure of that type built for the Hydraulic Laboratory of Cornell University; in connection with which an account is given of the device adopted for 'concentrating the contraction due to temperature changes in the concrete to a central point of weakness.' The resulting fissure was filled up in cold weather and continuity thus secured.

In the chapter on earthen dams mention is made of the ancient 'tanks' or storage basins, of Ceylon, one of which was closed in by an embankment 11 miles in length and 200 feet high; also of several in India. The other earthen dams mentioned are in Colorado and California, one of them (5.5 miles in length) serving to close in the Buena Vista Lake Reservoir, which has great extent (25,000 acres) but is only about 7 feet deep. As a result of this, the annual loss of water by evaporation is estimated at 70 per cent. of its capacity. However, when the evaporation is most active, the loss is made good continuously by the influx from the river.

The Ash Fork steel dam in Arizona, described on p. 222, was erected in 1897 and is an unusual construction, consisting of a number of vertical steel frames or trusses, connected or 'bridged over' at the upper side by curved plates of steel which form a continuous and water-tight covering. The structure is 33 feet high, 184 ft. long, and cost $45,000.

Natural reservoirs are next mentioned; *i. e.*, ready-made reservoirs or depressions, waiting only for water to be turned into them from neighboring streams of sufficient elevation and for suitable provision for its regulated escape.

The last chapter, on 'Projected Reservoirs,' is of considerable length and full of detail, treating of many irrigation surveys and projects for impounding water, throughout the Western States and Territories. Several of the structures mentioned are already in process of construction. An appendix of various tables made for the U. S. Geological Survey, and contoured maps of reservoir systems, complete the work.

A very commendable feature of Mr. Schuyler's book, and one that will be appreciated by civil engineers, is the information given as to the *cost* of many of the dams and other structures described in the work.

I. P. Church.

Annual Reports of the War Department: Report of the Chief of Ordnance. Washington, Govt. Print. 1900. 8vo. Pp. 474. Numerous appendices and plates.

The reports of the War Department always contain much of interest to the general reader and to the thoughtful citizen, apart from their purely technical matter, as, for example, the accounts of work performed under the River and Harbor Bill. Those of the Chief of Ordnance are particularly interesting to the student of metallurgy and to the engineer as giving much valuable information regarding materials. Occasionally a side-light is thrown upon interesting phases of governmental and official administration; as where the report of the chief of a bureau permits the reader to see the hand of the politician in the determination of the location of important locks, in river improvements in the West and the reason for the displacement of a worthy and capable officer insisting upon correct business methods, or where, as in the report before us, the official documents reveal the fact that a Committee of Congress, composed mainly if not entirely of non-experts, or amateurs at best, decides to 'try an experiment' with Government funds, to the extent of many thousands of dollars, directly against the expressed opinion of the official expert advisers of the Department and of Congress, or where official and expert authorities are permitted to be accused of refusing to permit the civilian expert reasonable opportunity to display his talent, and the charge is left without complete and decisive investigation and report. Amateurism is not altogether a monopoly with departments.

The Report of the Chief of Ordnance, proper, is a very brief, business-like and well-condensed summary of the operations of the bureau for the fiscal year ending June 30, 1900, covering 42 pages of the volume. The details of the work are exhibited in the remaining four hundred pages, in which are given forty appendices, mainly reports of officers charged by the Bureau with important duties and including the operations of the various arsenals.

Watervliet Arsenal, for example, has turned out during the year 45 ten- and twelve-inch rifles and mortars, and five smaller rapid-fire guns, and has made a large quantity of accessory material. Springfield Armory made about 60,000 army rifles and carbines and attained an output of 400 guns a day. Working eight hours a day, it now turns out about 200. As usual, a large amount of experimental work has been performed. Watertown Arsenal has been engaged upon sea-coast gun-carriages and its great testing-machines—it now has one of 200,000 pounds capacity, in addition to the older machine of 80,000 pounds—have performed a considerable amount of valuable scientific work in addition to that of the routine operation of the Department. Frankford Arsenal has made, during the year, 23,000,000 small-arm cartridges and can now issue about 90,000, per day of eight hours, continuously. Rock Island Arsenal turns out most of the infantry and cavalry equipments of the army. It makes blanket-bags at from $1 upward, haversacks at from 85 cents, canteens at 32 to 38 cents and tin cups cost but 10 cents to make. Costs have come down and wages gone up with the use of improved machinery. A new small-arms factory is under construction here, to produce 200 to 250 guns a day. Heavy guns for fortifications have been so extensively supplied that the Department is now turning its attention to the smaller rapid-fire guns. A muzzle velocity of 3,000 feet per second is to be attained in the later construction.

Wire-wound guns continue a subject of experiment, but still without complete success. It has come to be a question whether the disappearing gun-carriage for heavy mounts is best practice and whether it has not been too exclusively adopted. The Bureau does not express a decided opinion on this point. The automatically operating rapid-fire gun is reported upon and recently invented automatic pistols are the subject of investigation, with the result of choice of the Colt construction for army use, if later approved by the Department.

Interesting investigations of the composition of acceptable gun-steels give the valuable deduction that for an elastic limit of 70,000 to 75,000 pounds per square inch, and a tenacity of 100,000, with an elongation 15 to 20 per cent., the compositions should include about one-half of one per cent. carbon, one per cent. manganese, one-fifth to one-tenth per cent. silicon, and well under one-tenth of one per cent. of sulphur or phosphorus. Oil-tempering is not of advantage. Rolling is best performed at a temperature a little way below that of the blue 'critical heat.' One curiously interesting deduction is that the action of smokeless powder, or other high explosive, attaining a given pressure in the barrel of a gun, is less destructive than a similar pressure produced by ordinary static testing. The duration of the pressure is about 0.0004 second only, and time is thought to have an important influence upon results. The normal powder pressure in the army rifle is about 42,000 pounds per square inch. The singularly interesting phenomenon, extensively investigated by the writer many years ago, 'the exaltation of the normal elastic limit by strain,'* finds application here, as in so many other matters of applied science; the practice being now established of rolling and forging parts at a minimum temperature to insure high elastic limits and maximum tenacity.

R. H. THURSTON.

Experimental Psychology. A Manual for Laboratory Practice. By EDWARD BRADFORD TITCHENER. Volume I. Qualitative Experiments; Part I. Student's Manual. Pp. 214. Part II. Instructor's Manual. Pp. 456. New York, The Macmillan Co. 1901.

The place of laboratory practice in the teaching of psychology has, in American universities at least, become assured. It is by no means

* *Trans.* A. S. C. E., 1873. 'Materials of Engineering,' Vol. II., Chap. X.; Vol. III., Chaps. XIII., XIV.—R. H. T.